PELTI Flight Report for RF03 - 11 July, 2000

The objective of this flight was to vary the parameters that control the LTI's performance to see how the efficiency varies with these things. We used sea salt as the test aerosol (the day was nearly a minimum in dust concentration), by flying at 60 m most of the time. The flight was conducted to the east and slightly north of St. Croix.

We made the LTI {isokinetic/superisokinetic/ subisokinetic}, {turbulent/laminar}, and varied the suction percentage that controls both the enhancement and the losses in tubing bends. For each leg there was setup time to get the flows adjusted and the LTI software running, followed by the 10 minute period in which APS data was collected, and then a few minutes in which the hot-film anemometer probe was used to profile the flow at the rear of the porous diffuser.

[Note: The most reliable information on whether the LTI was isokinetic, laminar, etc. is on the DU computer, to which I don't have access. When that data is available we will produce a table listing times for various inlet conditions, APS integrations, and filter exposures so that other data – such as FSSP output – can be averaged over precisely those same times. The times noted below for each condition are from the APS, which was usually not started until the flow had been stabilized. If seconds are given, the time should be an accurate picture of the stable segment. -BJH]

No filters were exposed on the 15 minute legs, as there was insufficient time to get meaningful samples. TAS was not operational on this flight, as we lacked some parts.

1641	Takeoff
1642 – 1653	Sounding up to 2400 m (Roughly ENE)
	~700 m cloud base, ~1600 m tops
1653 – 1703	Level at 2400 m – LTI Flow/Pressure-drop check
1703:40 – 1717:30	Sounding down to 60 m in the MBL
	Turned East and remained at 60 m

Isokinetic LTI with various target sample flows to test enhancement.

1717	35 lpm – Min bend velocity, Laminar, FSSP flow off
1737	70 lpm – Laminar, FSSP on again
1757	95 lpm – Laminar
1813	Turned to West, still 60 m
1816	160 lpm – Barely turbulent
1831 - 1910	120 lpm – Barely laminar, Max bend velocity
1831 – 1910	Filters exposed
1847 – 1910	Good APS data (sample flow too high due during first part of leg)
1915	Turned to East, still 60 m
1922	190 lpm –Turbulent

Subisokinetic (by about 13%)

1942 - 2027	120 lpm – Barely laminar

1947 – 2027	Filter exposure
1957	Penetrated a rain shaft
2027	180 Turn to West, still at 60 m

Superisokinetic (by about 20%)

2039:02	120 lpm – Barely laminar

Isokinetic

2055	214 lpm – Turbulent
2055 – 2120	Filter exposure
2122 – 2132	Common-inlet APS and Neph calibration

2132:30 – 2143:15	Sounding up to 2400 m
2143 - 2146	Level at 2400 m
2146	Descent and Return to STX
2154	Landed at STX

Notes

- Some Teflon and Nuclepore filters broke. We are awaiting backings to support them on future flights. Chemical data shows LTI to be more efficient than the other inlets.
- The DU LFE sample flows sometimes disagreed with those from serial UH TFMs. This could introduce extra uncertainty into how closely we could set isokinetic flow.
- There may be a leak behind the internal FSSP-300 that allows flow when the FSSP valve is closed. The flowmeter also needs to be re-calibrated or exchanged for another. The cabin 300 seems to show larger concentrations above 3-4 um than the wing-mounted 300. To assure that this observations is not due to calibration differences, we will exchange 300 positions on each flight.
- The APS behind the NASA inlet was replaced before this flight: it behaved strangely, and will be replaced by the one that had been removed. NASA's APS data will not be considered valid for this flight.

Commentary

This was a successful flight for testing the LTI under a variety of conditions in sea salt. It would have been desirable to have higher salt concentrations, but the statistics of the APSs and FSSPs look satisfactory, certainly up to 7 um. It still takes quite a while to get all the sample and suction flows stabilized, resulting in the shortening of the time available for collecting data. Automating the LTI flow control to achieve isokinetic and laminar conditions would enable a much more efficient use of flight hours in subsequent programs. Is the double-peak structure behind the LTI real or an artifact of enhancement and plumbing losses? It is clear that the LTI admits more large particles than the other inlets under laminar flow conditions and even when somewhat turbulent. It is not clear, however, how much enhancement is occurring (in flight the different conditions didn't seem to make much difference, so their impact is subtle). At high turbulence, however, the LTI produces APS distributions that look very much like those from the other inlets. We still need TAS and APS data to address the issue of ambient/LTI differences.

-Barry Huebert, 17 July, 2000